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PATENT SPECIFICATION

Complete Specification Lodged .... 27th August, 1954.
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Applicant............Maschinenfabrik Augsburg-Nürnberg A. G.

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Convention Application
(Germany - 28th August, 1953)..

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Classification 66.7

Drawing attached.

COMPLETE SPECIFICATION.

"IMPROVEMENTS IN AND RELATING TO INJECTION NOZZLES FOR INTERNAL COMBUSTION ENGINES."

The following statement is a full description of this invention, including the best method of performing it known to us:-

This invention relates to an injection nozzle for internal combustion engines, more particularly Diesel engines, and the invention has for its object to improve the heat dissipation at the nozzle, which is necessary in consequence of thermal stresses.

For the reliable working of a Diesel engine the maintenance of a sufficiently low temperature of the injection nozzle is of great importance. In the case of nozzles of larger dimensions oil, power medium or water may be used for the direct cooling of the nozzle. In the case of small, high speed internal combustion engines the nozzles are so small, however, that such a method of cooling cannot be adopted. In this case other means must be used. Thus, it has for instance been proposed to provide the nozzle, more particularly in its forward part exposed to the combustion gases, with a copper sheath, by which the

heat is conveyed away upwards to well cooled regions. With this expedient a suitable cooling cannot, however, be realised in all cases, as with such an arrangement the surface acted on by the gases is not reduced, but rather increased. This is due to the circumstance, that the free gap provided between the nozzle shaft and the cylinder head in the usual manner has to be adhered to even in the case of a rolled-on copper sheath right to the tight-jointing seating, whereby the diameter of the heat-absorbing surface is increased and consequently the gas action also increased. Part of the favourable heat conducting effect of the copper sheat is in this way lost again.

A feature disadvantage of shrunk-on and rolled-on copper sheaths is, that, on the occurrence of a rise in temperature due to different material expansion between copper and steel, the union of the rolled-on copper sheath with the nozzle shaft necessarily becomes poorer, so that, on heating up, the transmission of heat between nozzle shaft and cooling copper sheath becomes less. It follows, that a cylindrical fit between the steel part to be cooled and the cooling copper sheath is not favourable, unless by special expedients which naturally increase the cost of the construction the differential material expansion is again compensated.

Now the invention avoids these disadvantages in principle by the expedient, that, in spite of the provision of a separate heat conducting part, the surface of the nozzle acted on by the gases is not enlarged, but considerably reduced. The problem to be solved constructionally consists in so forming and arranging the heat conducting part that, when the injection nozzle is in position, no free gap is left between nozzle shaft and cylinder head, so that only the nozzle end, in which the nozzle holes are bored, is in immediate contact with the gas, and that on the other hand, even when there is different heat expansion, intimate contact between nozzle shaft and the heat conducting part is always ensured. For solving this problem the invention proposes, that the heat conducting part is constructed as a conical tight-jointing body which can be slipped freely on to the nozzle shaft of the nozzle before the latter is inserted, but when the nozzle is in position, bears snugly both against the shaft and also in a conical bore of the cylinder head. On the conical jointing body a pressure is exerted, when the injection nozzle is mounted in the cylinder head, from the nozzle holder head by way of a resilient intermediate member, In this way, even when there is different heat expansion, intimate contact between nozzle shaft and heat-conducting part is ensured.

According to another constructional form of the invention the

conical jointing member is provided with a socket-like extension part which, when the nozzle is in position, extends into the cooling water space of the cylinder head, which surrounds the nozzle. The outer sheath surface of the extension part is directly laved by the cooling water. By this means the heat conduction at the nozzle is effectively assisted.

According to a further constructional form of the invention the conical jointing body may also be so constructed that it holds the nozzle shaft in the manner of a chuck. In this way a mode of fixing the nozzle is provided, in which excessive stresses may be easily avoided.

The invention will now be more particularly described with reference to the drawing illustrating several constructional examples.

In the accompanying drawings:

Figure 1 shows partly in cross-section and partly in elevation an injection nozzle built into the cylinder head of an internal combustion engine in accordance with the invention, a simple conical tight-jointing body being used as the heating;

Figure 2 a view similar to Figure 1, with the difference that the conical jointing body has an extension part which extends into the cooling water space surrounding the nozzle;

Figure 3 a view similar to Figures 1 and 2, in which the conical tight-jointing body has the form of a chuck engaging the nozzle shaft; and

Figure 4 a view similar to Figure 3, but with the conical tight-jointing body divided up into a plurality of individual parts which inter-engage in the manner of a chuck.

In the Figures similar parts bear the same reference numerals.

In Figure 1 the part 1 is the nozzle holder, to which is fixed by the nozzle nut 2 in the form of a cap nut the nozzle proper, the shaft 3 of which ends in the nozzle tip 4 with the atomising hole (not shown). On to the nozzle shaft 3 is slipped with a sliding fit a conical tight-jointing body or cone 5 of a material which is a good heat conductor and is plastic, for instance aluminium or copper, which, when the nozzle is in position, has its seating in the cooled part of the cylinder head 6 in a conical bore 7. The nozzle nut 2 is pressed by way of a spring intermediate member or pressure piece 8 by the ring nut 9 against the tight-jointing cone 5, so that a gas-tight closure is formed at 10. The pressure piece 8 has the form of a spring sleeve. In the cold state the tight-jointing cone 5 can be pushed on to the nozzle shaft 3 which may be cylindrical, but may also be made conical similar to the cone 5.

The mode of construction according to the invention operates in the following manner:

When through the running of the engine the cylinder head and the nozzle become heated up, the conical tight-jointing body 5 which has a greater heat expansion than the nozzle shaft 3 seeks to expand. Through the spring pressure piece 8 resistance is however offered to the expansion in the direction towards the nozzle holder head. Owing to the conical fit of the jointing body 5 in the bore 7 the jointing cone 5 is forced for increasing its volume to expand inwards, so that the fit between the shaft 3 and the cone 5 becomes a press fit. The extent of pressing is determined by the power of resistance of the spring pressure piece 8 and the taper of the cone 5 in the cylinder head 6, the pressing pressure being kept such that a deformation of the nozzle is avoided.

On heating up, the surface contact between the nozzle shaft 3 and the conical tight-jointing body 5 on the one hand and between the latter and the cylinder head 6 on the other hand is further improved by the pressing pressure thus created.

Through the provisions according to the invention the entrance of gas between the tight-jointing body 5 and the shaft 3 is thus effectively prevented and consequently the heating which would be caused by the entrance of gas. On the other hand very favourable heat transmission conditions from the nozzle shaft 3 by way of the tight-jointing body 5 to the cooled cylinder head 6 are created.

What happens on the parts becoming heated up, as described, provides a further advantage, when the nozzle is to be removed. If the injection nozzle be removed, when the engine is in the heated up state, the tight-jointing body 5 together with the nozzle shaft 3 are withdrawn out of the cylinder head 6, as the pressing pressure between the parts 5 and 3, when the parts are hot, results in a tight fit. If the removal be effected, however, when the cylinder head is cold, the conical tight-jointing body 5 will remain jammed in the cylinder head 6, so that the nozzle shaft 3 can in this case be withdrawn out of the tight-jointing cone 5.

In Figure 2 a constructional form of the invention is shown, in which besides a good tight-jointing and heat conduction a particularly good cooling effect is also obtained. For this purpose the tight-jointing cone 5 which is for the rest slidable on to the nozzle shaft 3 as in the previous example is provided with an extension part 11 which, when the nozzle is in position, extend into the cooling water space 12 in the cylinder head 6, which surrounds the nozzle, and is there directly layed by the cooling water. On the other hand, in order to prevent water

entering the cylinder, when the nozzle is removed, the tight-jointing cone 5 is initially stressed by way of the extension part 11 and a further sleeve 13 by the ring nut 14, the tight-jointing effect at 9 being again brought about by way of the nozzle holder 1 or the nozzle nut 2 in the manner described with reference to the arrangement in Figure 1. Between the parts 10, 11, 14 additional packing rings 15, 16 may be interposed in a known manner.

The nozzle construction illustrated in Figures 1 and 2 requires great fitting accuracy, in order to avoid any jamming of the nozzle on the shaft. A constructional form which will definitely prevent such jamming is shown in Figure 3. In this arrangement the nozzle support is no longer brought about by a pressure on the nozzle nut 2 or the nozzle holder 1, but the tight-jointing cone is provided with an extension part 17 which is taken up into the nozzle holder head, the cone 5 being pressed from there by the ring nut 9 by way of an intermediate disc 18 and the expanding ring 19 into the conical seating 7 of the cylinder head 6. By this means the diameter of the bore in the tightening cone 5 is reduced, so that the nozzle shaft 3 is held as in a chuck. Gas tightness is in this case already obtained by this pressure between nozzle shaft 3 and tight-jointing cone 5. Any jamming of the nozzle holder and the nozzle holder and the nozzle can therefore no longer occur, as the nozzle holder will set itself entirely in accordance with the bore in the cone 5. In order to prevent an unintentional forcing out of the nozzle holder, intermediate rings 20 are provided, against which the nozzle nut 2 bears, when the gas pressure forces the nozzle shaft 3 outwards, owing to the connnection between the parts 5 and 3 having inadvertently been made too loose. A rubber ring 21 prevents water entering the cylinder, when the nozzle is being removed. The expanding ring 19 which has clearance at its groove in the direction towards the combustion chamber, but not in the opposite direction, provides that the tight-jointing cone 5 shall not inadvertently come out upwards out of the head along with the nozzle holder 1, when the latter is being withdrawn.

In the constructional form in Figure 4 the tight-jointing cone 5 and the extension part 17 are separate parts which engage one in the other in the manner of gripping jaws, which may be of advantage in certain cases. For the rest this constructional form does not differ fundamentally from the constructional form according to Figure 3.

The invention is not restricted to the constructional example described above and further alterations and modifications are possible, more particularly as regards the form of the individual parts, which are to be regarded as being covered by the invention. Thus, for

instance, the conical seating surface of the tight-jointing body 5 might be divided by cut-in annular grooves whereby the fit at the conical bore 7 will be improved, without the gas tightness or heat transmission suffering.

The claims defining the invention are as follows:-

1. Injection nozzle for internal combustion engines, more particularly Diesel engines, in which a heat conducting part of higher heat conductivity than the surrounding material is provided, by which heat coming more particularly at the end of the nozzle from the cylinder is rapidly conducted away, characterised by the feature, that this heat conducting part is formed as a conical tight-jointing body which is adapted to be slipped on to the nozzle shaft before the insertion of the nozzle, but which, when the nozzle is in position, fits snugly both at the nozzle shaft and in a conical bore of the cylinder head.
(28th August, 1953)

2. Injection nozzle as claimed in Claim 1, characterised by the feature that on the tight-jointing body, when in position, a pressing pressure is exerted by way of a spring intermediate member from the nozzle holder head. (28th August, 1953)

3. Injection nozzle as claimed in Claim 1, characterised by the feature that the conical tight-jointing body has a sleeve-like extension part which, when the nozzle is in position extends right in into the cooling water space of the cylinder head and is there directly laved by the cooling water. (28th August, 1953)

4. Injection nozzle as claimed in Claim 3, characterised by the feature that the conical tight-jointing body with the extension part is, when the nozzle is in position, initially stressed by way of an adapter sleeve from the nozzle holder head. (28th August, 1953)

5. Injection nozzle as claimed in Claim 1, characterised by the feature that the conical tight-jointing body has a sleeve-like extension part which extends as far as the nozzle holder head and can there be clamped in such a manner that the tight-jointing body holds the tight-jointing shaft in the manner of a chuck. (28th August, 1953)

6. Injection nozzle as claimed in Claim 5, characterised by the feature that the sleeve-like extension part and the conical tight-

jointing body are made as separate parts which, when the nozzle is in position, engage one in the other in the manner of chuck jaws. (28th August, 1953)

7. The improved injection nozzle for internal combustion engines, more particularly Diesel engines, substantially as described with reference to the accompanying drawings. (28th August, 1953)

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Patent Attorneys for Applicant.

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Serial No.	Application No.	Classification.
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129,112	24,666/45	66.7
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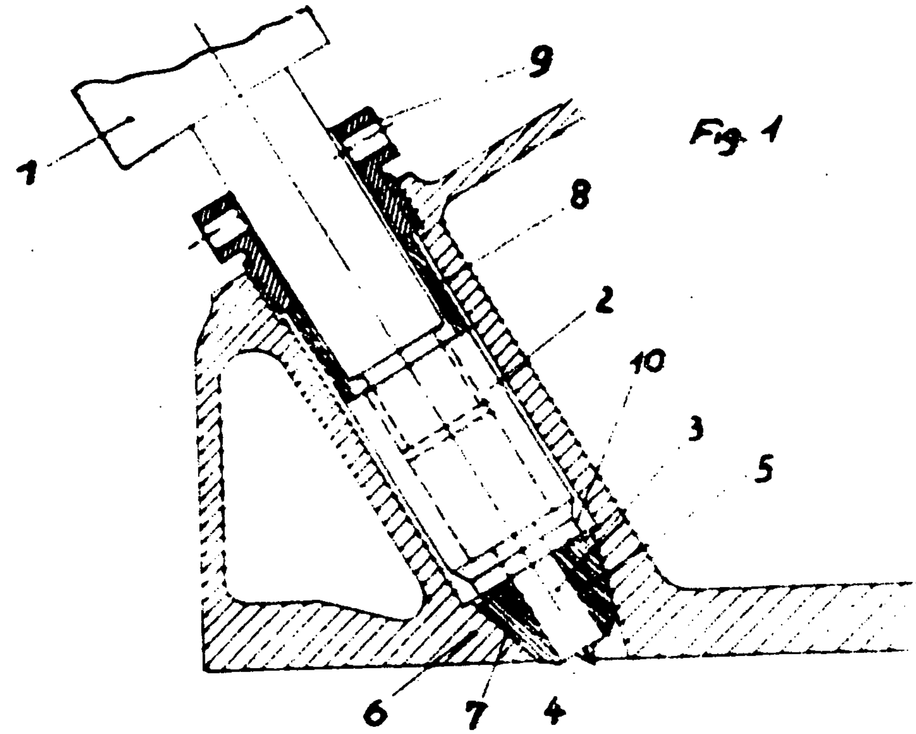

Fig. 1

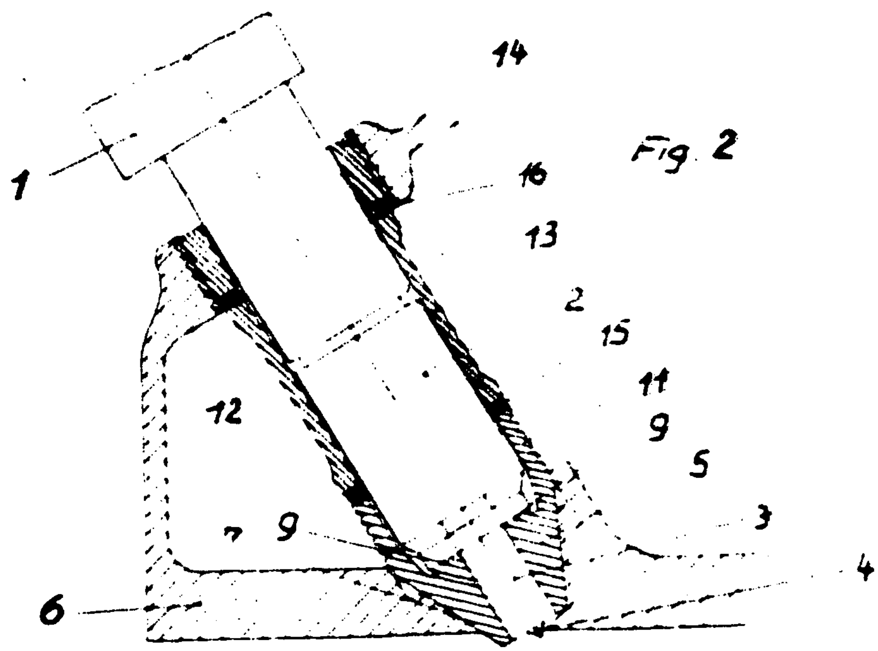

Fig. 2

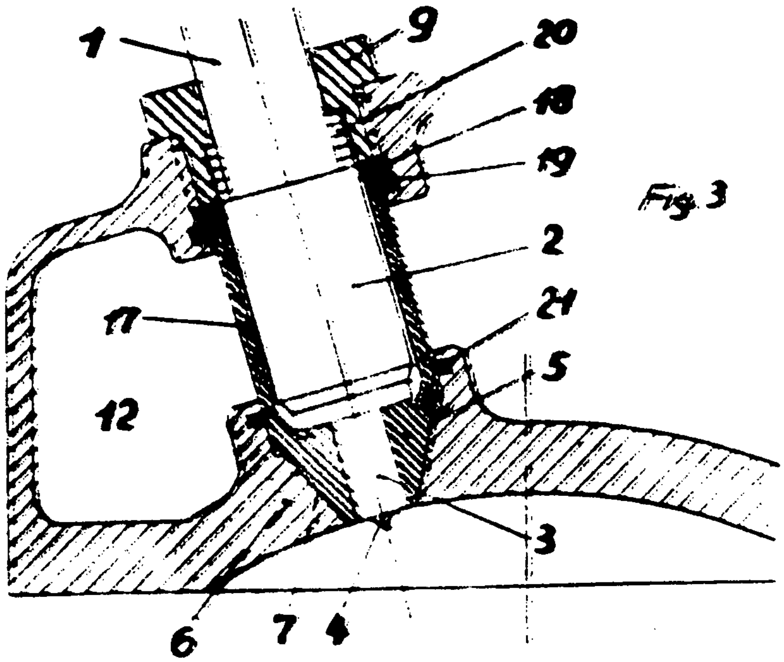

Fig. 3

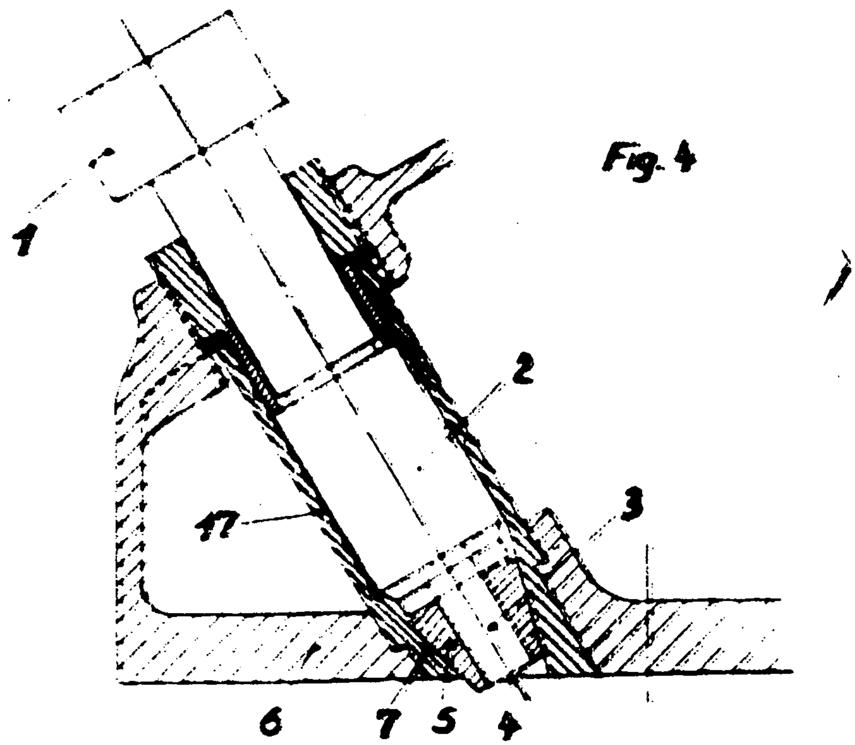

Fig. 4

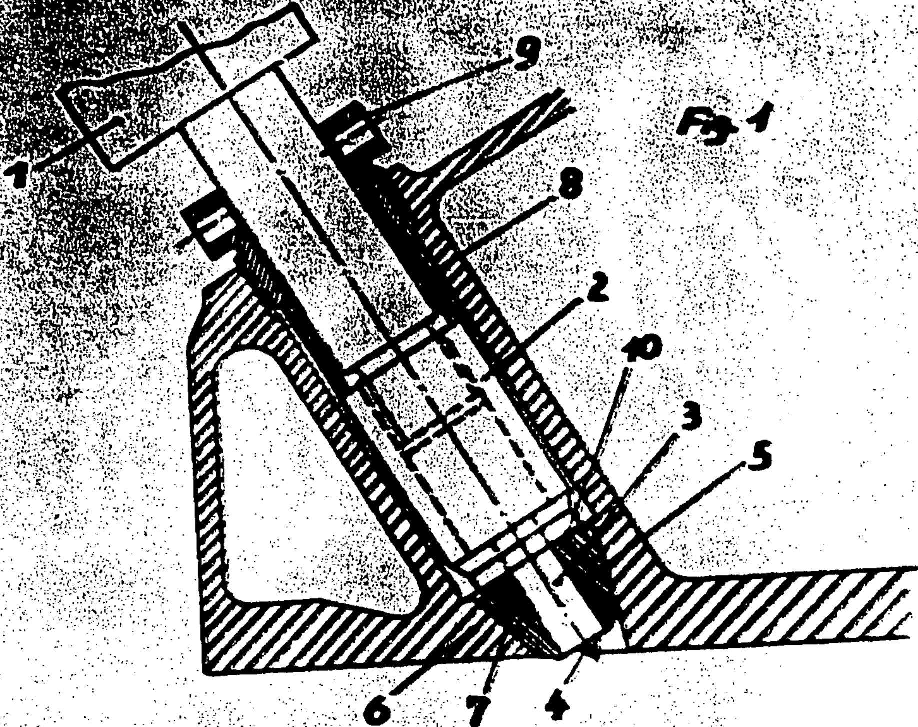

Fig. 1

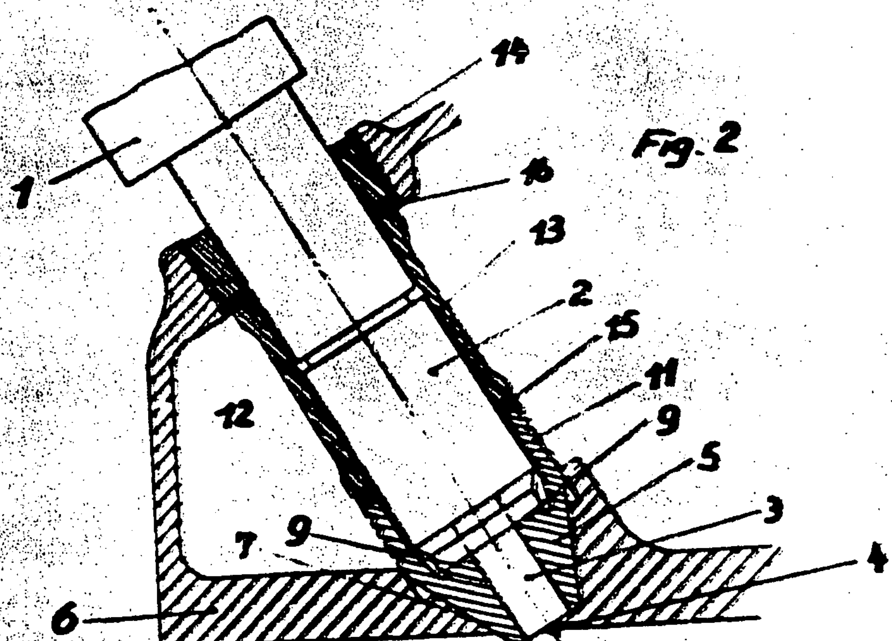

Fig. 2

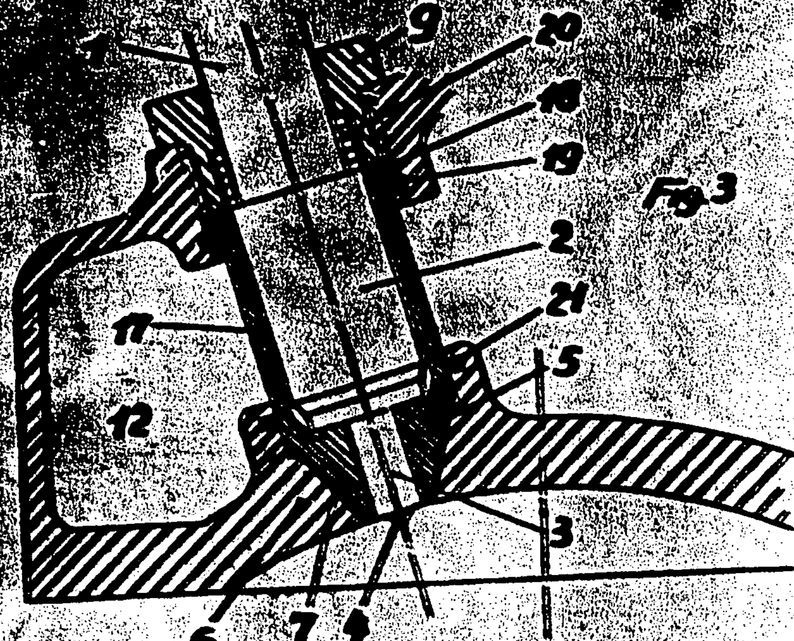

Fig. 3

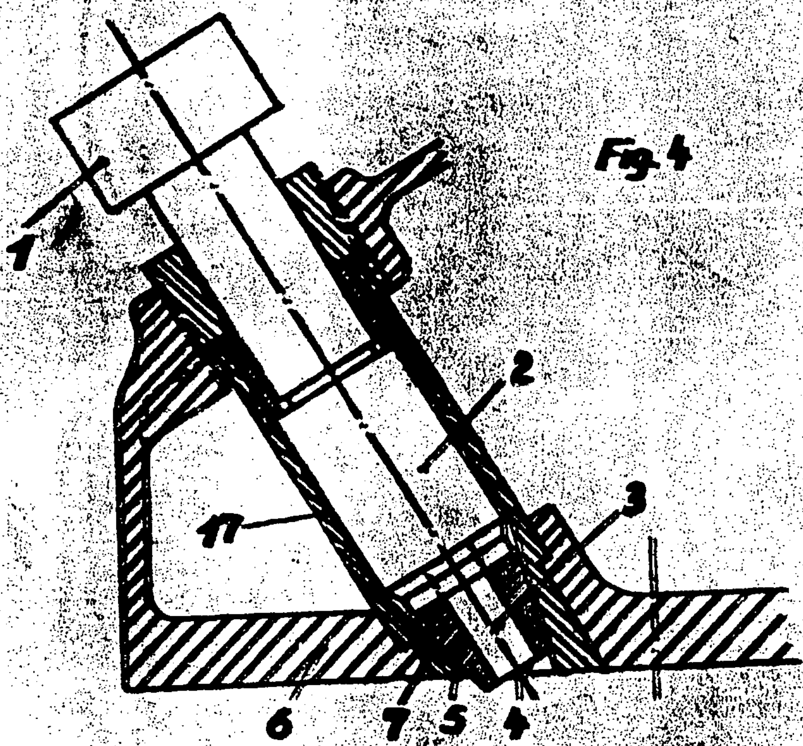

Fig. 4